Project Instructions

Date Submitted: July 15, 2011

Platform: NOAA Ship *Ronald H. Brown*

Project Number: RB-11-02

Project Title: CLIVAR A10 Expedition

Project Dates: 28 August 2011 to 1 October 2011

Prepared by: M. O'Neil Baringer — Dated: 8/10/2011

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Chief Scientist
NOAA/AOML

Approved by: Alan Leonardi — Dated: 8/10/2011

For Dr. Robert Atlas
Director
NOAA/AOML

Approved by: ________________________ Dated: ______________

Captain David A.Score, NOAA
Commanding Officer
Marine Operations Center - Atlantic

PROJECT OVERVIEW

A. Summary

This project will be part of a decadal series of repeat hydrography sections jointly funded by NOAA-OGP and NSF-OCE as part of the CLIVAR/CO_2/hydrography/tracer program (http://ushydro.ucsd.edu). Academic institutions and NOAA research laboratories will participate. The program focuses on the need to monitor inventories of CO_2, tracers, heat and freshwater and their transports in the ocean. Earlier programs under World Ocean Circulation Experiment (WOCE) and Joint Global Ocean Flux Study (JGOFS) have provided a baseline observational field for these parameters. The new measurements reveal much about the changing patterns on decadal scales. The program serves as a backbone to assess changes in the ocean's biogeochemical cycle in response to natural and/or man-induced activity. Global changes in the ocean's transport of heat and freshwater, which can have significant impact on climate, can be followed through these long-term measurements. The Repeat Hydrography Program provides a robust observational framework to monitor these long-term trends. The goal of the effort is to occupy a set of hydrographic transects with full water column measurements over the global ocean to study physical and hydrographic changes over time. These measurements are in support of:

* Model calibration and validation
* Carbon system studies
* Heat and freshwater storage and flux studies
* Deep and shallow water mass and ventilation studies
* Calibration of autonomous sensors

This program follows the invasion of anthropogenic CO_2, CFCs and other tracers into intermediate and deep water on decadal timescales and determines the variability of the inorganic carbon system, and its relationship to biological and physical processes. More details on the program can be found at the website referenced above and details of this particular project can be found at http://www.aoml.noaa.gov/ocd/gcc/A10/.

Full water column CTD/rosette casts will be made along the project track (nominally along the 30˚S latitude line from 15˚E to 55˚W) with stations at approximately 30 nautical mile spacing. Several Argo profiling CTD floats and drifting buoys will be deployed along the section. Near surface seawater (temperature, salinity, pCO_2, ADCP) and atmospheric measurements (CO_2, CFCs and ozone) will be made.

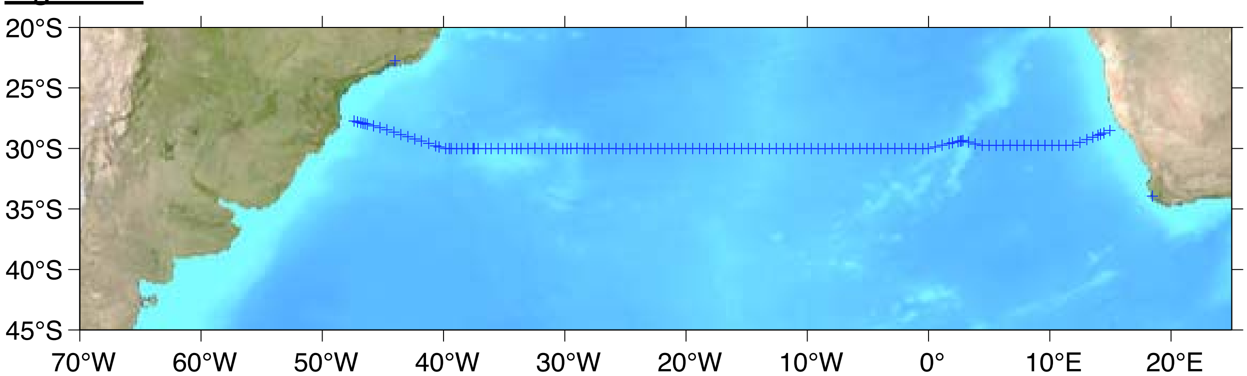
The operations on this project will be similar to those on previous CLIVAR Repeat Hydrography projects completed on NOAA Ship *Ronald H. Brown*, including projects RB-03-01, RB-04-13, RB-07-11, RB-08-01, RB-09-07, RB-10-02 and on CLIVAR projects recently completed on a

number of UNOLS research vessels, including R/V *Melville,* R/V *Thompson* and R/V *Revelle*. On these previous CLIVAR projects a 36 position, 10-liter bottle rosette was used as the primary sampling package. On RB-11-02, we will use a smaller (24 position) rosette as our primary sampling package.

B. Operating Area

The RB-11-02 project is comprised of one leg involving scientific activities. The project will focus on completing a long zonal section across the South Atlantic, nominally along the 30˚S latitude line (See Figure 1). The section repeats part of the projects conducted in 1992 and 2003. . The upcoming project will yield a first comprehensive snapshot of changes in anthropogenic CO_2 and tracer inventories and hydrographic changes in the region over the past 25 years and complete the global decadal-repeat CO2 survey begun in 2002. Full water column CTD stations will be occupied at 30 approximately nautical mile intervals or closer and include collecting water samples from Niskin bottles for a variety of physical, chemical and biological parameters. During the transit from Cape Town to the start of the line a few brief (~1-2 hour each) test casts may be performed to check the CTD/rosette package and collect water samples for instrument testing. These tests will involve stopping the ship and lowering the package into the water. The locations of these tests will be chosen once the analytical gear is running, and in consultation with the ship's captain.

Figure 1. Station locations for the CLIVAR/CO2 A10.



C. Participating and Affiliated Institutions:

AOML	Atlantic Oceanographic and Meteorological Laboratory - NOAA
CPO	Climate Program Office - NOAA
LDEO	Lamont-Doherty Earth Observatory/Columbia University
PMEL	Pacific Marine Environmental Laboratory - NOAA

Princeton	Princeton University
RSMAS	Rosenstiel School of Marine and Atmospheric Science/University of Miami
SIO	Scripps Institution of Oceanography/University of California at San Diego
UCSB	University of California Santa Barbara
UCI	University of California Irvine
U Hawaii	University of Hawaii at Manoa
WHOI	Woods Hole Oceanographic Institution

D. Data to be collected: Lead PI

ADCP/LADCP:	Jules Hummon - UH
Alkalinity/pH:	Andrew Dickson - SIO
CFC/SF6:	John Bullister - PMEL
CTD:	Gregory Johnson - PMEL/Molly Baringer - AOML
14C/13C:	Robert Key - Princeton/Ann McNichol – WHOI/Alan Foreman - SIO
Data Management:	James Swift - SIO/Kristin Sanborn - SIO
DOC/TDN:	Dennis Hansell - RSMAS
Dissolved Oxygen:	Molly Baringer - AOML/Chris Langdon - RSMAS
Helium/Tritium:	Peter Schlosser - LDEO/William Jenkins - WHOI
Nutrients:	Calvin Mordy, PMEL/Jia-Zhong Zhang - AOML
Observers:	Steve Piotrowicz - CPO
pCO2 (UW & Discrete)	Rik Wanninkhof - AOML
Salinity:	Molly Baringer - AOML
Total CO2 (DIC):	Richard Feely - PMEL/Rik Wanninkhof - AOML

Personnel on RB 11-02: (Cape Town, South Africa to Rio, Brazil)

Personnel on CLIVAR/CO2 Repeat Hydrography Project (NOAA Ship Ronald H. Brown):

	Function	***Name***	***Institution***	***Gender***	***Nationality***
1	Chief Scientist	Martha (Molly) Baringer	AOML	F	US
2	Co-Chief Scientist	Alison Macdonald	WHOI	F	United Kingdom
3	Data Management	Alex Quintero	Scripps	M	US
4	CTD Processing	Kristene McTaggert	PMEL	F	US
5	CTD/Salinity/LADCP/ET	Kyle Seaton	AOML /CIMAS	M	US
6	CTD/Salinity/LADCP/ET	Andrew Stefanick	AOML	M	US
7	CTD Watch	James Hooper	Scripps	M	US
8	CTD Watch	Elizabeth Simons	FSU	F	US
9	ACDP/LADCP	Sarah Eggleston	U Hawaii	F	US
10	Dissolved O2	George Berberian	AOML	M	US
11	Dissolved O2	Chris Langdon	RSMAS	M	US
12	Nutrients	Peter Proctor	PMEL	M	US
13	Nutrients	Charles Fischer	AOML	M	US

14	Total CO2 (DIC)	Charles Featherstone	AOML	M	US
15	Total CO2 (DIC)	Robert Castle	AOML	M	US
16	CFCs/SF6	David Wisegarver	PMEL	M	US
17	CFCs/SF6	Darren Pilcher	U Wisconsin	M	US
18	CFCs/SF6	Alan Foreman	North Carolina State	M	US
19	Total Alkalinity/pH	Jen Aicher	RSMAS	F	US
20	Total Alkalinity/pH	Tammy Laberge-MacDonald	RSMAS	F	Canadian
21	Total Alkalinity/pH	Carmen Rodriguez	RSMAS	M	US
22	Total Alkalinity/pH	Valentina Caccia	RSMAS	M	Mexican
23	Helium/Tritium/o18	Anthony Dachille	LDEO	M	US
24	DOC/DON/bacterioplankton	John Blake Clarke	UCSB	M	US
25	DOC/C14	Alysha Coppola	UCI	F	US
26	HPLC/Phytoplankton	Rafael Gonçalves Araujo	FURG	M	Brazil
27	HPLC/Phytoplankton	Luciano Costa de Lacerda Azevedo	FURG	M	Brazil
28	Brazilian Observer	TBA			Brazil
29	Namibian Observer	TBA			Namibia

E. Administrative

Chief Scientist: Dr. Molly Baringer
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AOML.Associate.Directorv@noaa.gov

RB Operations Officer: LT James Brinkley, NOAA
OPS.Ronald.Brown@noaa.gov

Clearances:

Research clearance is being requested for South Africa, Namibia and Brazil. The requests are being submitted to the State Department by Wendy Bradfield-Smith <Wendy.Bradfield-Smith@noaa.gov>

F. Foreign National Access and Deemed Export Controls

All foreign national access to the vessel shall be in accordance with NAO 207-12 and RADM De Bow's March 16, 2006 memo (http://deemedexports.noaa.gov). The foreign national's sponsor is responsible for obtaining clearances and export licenses required and for providing for required escorts by the NAO. Programs sponsoring foreign nationals should consult with their designated line office personnel to assist with the process (http://deemedexports.noaa.gov/contacts.html).

The following are basic requirements. Full compliance with NAO 207-12 is required.

Responsibilities of the Chief Scientist:

Ensure the following is provided to the Commanding Officer before any foreign national will be allowed on board for any reason:

1. Written notification identifying the NOAA Program individual who is responsible for ensuring compliance with NOAA and export regulations for the foreign national (see Foreign National Sponsor responsibilities below).
2. A copy of the DOC/OSY clearance authorization for access by the foreign national.
3. A copy of Appendix B of NAO 207-12 with NOAA Chief Administrative Officer concurrence endorsement.
4. Written notification that the foreign national has been cleared against the State, Commerce and Treasury departments' Lists to Check. http://www.bis.doc.gov/ComplianceAndEnforcement/ListsToCheck.htm

5. Provide the NOAA Foreign National List spreadsheet for each foreign national in the scientific party.

Escorts – The Chief Scientist is responsible to provide escorts to comply with NAO 207-12 Section 5.10, or as required by the vessel's DOC/OSY Regional Security Officer.

Ensure all non-foreign national members of the scientific party receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the servicing Regional Security Officer.

Export Control - The Chief Scientist is responsible for complying with NAO 207-12 and the development of Technology Access Control Plans for items they bring aboard. The Chief Scientist must notify the Commanding Officer of any export controlled items they bring aboard and any access restrictions associated with these items.

The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.

Responsibilities of the Commanding Officer:

Ensure only those foreign nationals with DOC/OSY clearance are granted access.

Deny access to OMAO platforms and facilities by foreign nationals from countries controlled for anti-terrorism (AT) reasons and individuals from Cuba or Iran without written NMAO approval and compliance with export and sanction regulations.

Ensure foreign national access is permitted only if unlicensed deemed export is not likely to occur.

Ensure receipt from the Chief Scientist of the NOAA Foreign National List spreadsheet for each foreign national in the scientific party.

Ensure Foreign Port Officials, e.g., Pilots, immigration officials, receive escorted access in accordance with maritime custom to facilitate the vessel's visit to foreign ports.

Export Control - 8 weeks in advance of the Project, provide the Chief Scientist with a current inventory of OMAO controlled technology onboard the vessel and a copy of the vessel Technology Access Control Plan (TACP). Also notify the Chief Scientist of any OMAO-sponsored foreign nationals that will be onboard while program equipment is aboard so that the Chief Scientist can take steps to prevent unlicensed export of Program controlled technology.

The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.

Ensure all OMAO personnel onboard receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the servicing Regional Security Officer.

Responsibilities of the Foreign National Sponsor

Export Control - The foreign national's sponsor is responsible for obtaining any required export licenses and complying with any conditions of those licenses prior to the foreign national being provided access to the controlled technology onboard regardless of the technology's ownership.

The Departmental Sponsor/NOAA of the foreign national shall assign an on-board Program individual, who will be responsible for the foreign national while on board. The identified individual must be a U.S. citizen, NOAA (or DOC) employee. According to DOC/OSY, this requirement cannot be altered.

Ensure completion and submission of Appendix C (Certification of Conditions and Responsibilities for a Foreign National Guest) as required by NAO 207-12 Section 5.03.h.

OPERATIONS

A. Data to be collected

1. CTD profiles of depth along hydrographic transects. Approximately 125 stations will be completed to full water depth, with an estimated maximum of 6000 meters.
2. Water samples collected in rosette bottles for comparison with the CTD profiles.
3. Profiles of northward and eastward velocity from the LADCP.
4. Salinity of the water samples collected with the bottles.
5. Dissolved oxygen, nutrients, carbon system parameters in the water samples collected with the bottles.
6. Trace gases (chlorofluorocarbons, sulfur hexafluoride, helium) in the water samples collected with the bottles.
7. Continuous recording of ship mounted ADCP data.
8. Heading data from the POS MV system for correction and processing of shipboard ADCP data.
8. Continuous recording of Thermosalinograph (TSG).
9. Continuous recording of Seabeam bathymetry requested (with help from ship Survey Dept.)
10. Nutrient concentrations of the water samples collected with the bottles.
11. Full carbon characterization of the water samples collected with the bottles.
12. Ocean color from the SAS system mounted on the bow tower.
13. Microwave radiometer (Univ. Miami)

14. Marine Atmospheric Emitted Radiance Interferometer (M-AERI) (an infrared Fourier transform spectrometer (FTS)) to measure uplooking and downlooking spectral radiances, marine boundary layer profiles of temperature and water vapor, and skin SST (Univ. Miami)
15. Deployment of 10 Argo floats
16. Deployment of 10 surface drifting buoys of the Global Drifter Program

B. Staging Plan

Staging of the US equipment for the project was conducted in Charleston, SC in July 2011 in consultation with ship and with the chief scientists of preceding and following projects. Four twenty-foot shipping/laboratory containers with equipment and an additional CTD frame were loaded on the ship. All chemicals were accompanied by MSDS. All chemicals, except compressed gases and those packaged according to DOT regulations in the shipping/laboratory containers, were stored in the HazMat locker. A list of equipment and chemicals brought aboard provided in Appendix A-E.

AOML's 20-ft container with equipment for PNE and CLIVAR will be loaded for RB-11-01 in the time period July 11—13. The DIC and CFC vans will also be loaded in Charleston and request placement on the fantail aft with electricity.

Copies of equipment lists, including country of origin were supplied to the CO and Chief Scientist prior to the departure of the ship from Charleston. It is the responsibility of each group of investigators to arrange for shipping their equipment to and from *Ronald H. Brown*, including preparing all necessary customs or export/import documentation, and transfers to the ship.
The science party will meet the ship in Cape Town. The science party will plan to move aboard on the night before sailing. We understand the galley may not be available for science party meals before sailing. Loading by science party and setup will occur throughout the in-port. We will require the assistance of the shipboard ET and Survey Technician and other shipboard personnel for 8 hours on three-days prior to sailing and connect ship power to the laboratory vans, to install computer systems, and to make terminations for the CTD as well as to aid in the setup of other science equipment.

C. Project Plan

NOAA Ship *Ronald H. Brown* (RB) will depart Cape Town, on 28 August 2011, to begin scientific operations. The primary goals of the project are to sample along previously occupied hydrographic section. All attempts will be made to reoccupy the CTD stations as closely as possible (see station listing below). The actual hydrographic stations sampling plan may deviate from this proposed plan in both number of stations and their locations.

The project will proceed from Cape Town to the start of the line at 28.52˚S, 14.95˚E, performing one or more test CTD casts en route. The exact location of the test station(s) will be determined in consultation with the Commanding Officer. We will then begin the CTD section along the nominal latitude of 30°S. Upon completion of the CTD section at nominally 27.73°S 47.38°W we will go into port.

We require that the ship suspend pumping and dumping for, at minimum, the last 500 m of the CTD upcasts. The ship should also suspend any operations (e.g., incineration, paint chipping, deck washing, etc.) during this period if these activities lead to release of quantities of material into the surface water in the area where the rosette is recovered.

A map of the station locations is shown in Figure 1.

D. Station Locations

Station Locations are listed in Table 1. These are subject to change.

Sta #	Lat (dec)	Lon (dec)
1	-28.52	14.95
2	-28.72	14.47
3	-28.82	14.18
4	-28.92	13.97
5	-29.07	13.55
6	-29.27	13.05
7	-29.50	12.48
8	-29.73	11.90
9	-29.75	11.33
10	-29.75	10.75
11	-29.75	10.18
12	-29.75	9.60
13	-29.75	9.03
14	-29.75	8.45
15	-29.75	7.88
16	-29.75	7.30
17	-29.73	6.73
18	-29.75	6.15
19	-29.75	5.58
20	-29.75	5.00
21	-29.75	4.43

22	-29.63	3.85
23	-29.47	3.30
24	-29.35	2.83
25	-29.38	2.70
26	-29.40	2.62
27	-29.43	2.43
28	-29.53	1.97
29	-29.60	1.69
30	-29.73	1.12
31	-29.87	0.54
32	-30.00	-0.03
33	-30.02	-0.48
34	-30.02	-1.06
35	-30.00	-1.63
36	-30.00	-2.21
37	-30.00	-2.78
38	-30.00	-3.36
39	-30.00	-3.93
40	-30.00	-4.51
41	-30.00	-5.08
42	-30.00	-5.66
43	-30.00	-6.23
44	-30.02	-6.81
45	-30.00	-7.38
46	-30.00	-7.96
47	-30.02	-8.53
48	-30.02	-9.11
49	-30.00	-9.68
50	-30.00	-10.26
51	-30.00	-10.83
52	-30.02	-11.41
53	-30.00	-11.98
54	-30.00	-12.56
55	-30.02	-13.13
56	-30.00	-13.71
57	-30.00	-14.28
58	-30.00	-14.86
59	-30.00	-15.43

60	-30.00	-16.01
61	-30.00	-16.58
62	-30.02	-17.16
63	-30.00	-17.73
64	-30.02	-18.31
65	-30.00	-18.88
66	-30.00	-19.46
67	-30.00	-20.03
68	-30.00	-20.61
69	-30.00	-21.18
70	-30.00	-21.76
71	-30.00	-22.33
72	-30.00	-22.91
73	-30.00	-23.48
74	-30.00	-24.06
75	-30.02	-24.63
76	-30.02	-25.21
77	-30.00	-25.78
78	-30.00	-26.36
79	-30.00	-26.93
80	-30.00	-27.51
81	-30.00	-28.08
82	-30.00	-28.40
83	-29.98	-29.00
84	-30.00	-29.50
85	-30.00	-29.82
86	-30.00	-30.17
87	-30.00	-30.74
88	-30.00	-31.32
89	-30.00	-31.89
90	-29.98	-32.47
91	-30.00	-33.04
92	-30.00	-33.62
93	-30.00	-33.97
94	-30.00	-34.34
95	-30.00	-34.92
96	-30.00	-35.49
97	-30.00	-36.07

98	-30.00	-36.53
99	-30.00	-37.15
100	-30.00	-37.47
101	-30.00	-37.57
102	-30.00	-38.02
103	-30.00	-38.50
104	-30.02	-38.92
105	-30.00	-39.38
106	-30.00	-39.53
107	-30.00	-39.83
108	-29.88	-40.37
109	-29.78	-40.65
110	-29.58	-41.22
111	-29.38	-41.83
112	-29.22	-42.38
113	-29.02	-42.95
114	-28.85	-43.53
115	-28.65	-44.10
116	-28.45	-44.68
117	-28.27	-45.25
118	-28.13	-45.78
119	-28.00	-46.30
120	-27.95	-46.47
121	-27.92	-46.65
122	-27.87	-46.83
123	-27.80	-47.10
124	-27.73	-47.38

Table 1: Stations locations are given in decimal degrees with positive degrees representing East (North) Longitudes (Latitudes) and negative decimal degrees representing West (South)) Longitudes (Latitudes).

E. Station Operations

The preliminary personnel task assignments are indicated with each operation. The chief scientists and the Commanding Officer will determine final responsibilities.

a.) **Full water column CTD/Rosette Casts** (Ship and scientific personnel)

CTD casts will include the user supplied CTD/O2 unit, a Lowered ADCP unit and a 24-position 11-liter bottle Rosette sampler. Approximately 125 casts will be conducted to full water column depth, maximum estimated at 6000 meters. We will require a package tracking system and display for the CTD operations (Knudsen/Bathy2000/Bathy2010). We request that the ship provide an 8000 + m back-up CTD conducting capable wire for this project.

It is of utmost importance to the success of the expedition that the ship be able to hold position at all times during the CTD casts, and that the CTD winch, meter wheel, hydraulic frame, conducting cable and backups function properly during this expedition. Both primary and secondary winches must contain full lengths of CTD conducting cable in good condition and be outfitted to deploy the primary or secondary CTD. That is both should be fully rigged. Skilled ship personnel and adequate spare parts must be available on all legs to assure that this equipment is maintained in good working order. The ship's personnel must be skilled in CTD wire re-terminations, and adequate ship's supplies of materials for CTD wire re-terminations must be available. Since typical steaming time between stations is less than 3 hours, re-terminations of the conducting cable (when required) must be completed within 23 hours.
The CTD/rosette system will be deployed off the starboard side. During recovery, the CTD/rosette package will be lowered onto platform that can be tugged into the staging bay by the user supplied rail system that was fitted and installed in Charleston (the same system used on the A13.5 RB-10-02 project). The size and weight of the package and frequent deployment is such that all mechanical components of winch and wire must be in excellent operating condition including optimal fleet angle, wire wrapping, and sheave diameter. In addition to this primary system, at least one other scientific party supplied 24-postion 11-lit water bottle package will serve as back-up. A pinger and altimeter will be mounted on the rosette systems and used during casts to monitor distance from the bottom. We anticipate that during most casts, the CTD/rosette will be lowered within about 10 meters of the bottom. The ship's Precision Depth Recorder (PDR) must be working properly for this purpose.

The winch, wire and meter wheel must be capable of routinely making casts up to 6000-m with these rosette systems. During the casts, if needed and available, ship's personnel will assist the CTD operators monitoring of the bathymetric recorder and pinger signal and to properly assess the distance of the rosette package off the bottom. The ship's electronics technician will share responsibility with the scientific party for maintaining good electrical and mechanical connections between the CTD/rosette system, the conducting cable and winch slip-rings, and to the deck unit for the CTD/rosette system.

Ship and scientific personnel will mutually assist in the deployment and recovery of the CTD/rosette. A number of members of the scientific party have experience with CTD deployments. Members of the scientific party will be responsible for collecting the water samples from the rosette. Members of the scientific party will also be responsible to collect oxygen, nutrient, carbon, CFC and salinity samples and recording sample ID's. Particular care will be taken in the collection and analysis of water samples to assure that all properties are measured with the greatest accuracy possible. Many of the chemical measurements are sensitive to contamination from soot, oils, solvents, spray cleaners, lubricants, paints, hydraulic fluid, and other substances. The chief scientists and watch stander should be notified prior to the use of these substances. Care must be taken to avoid contamination of the rosette system with these substances. Smoking is prohibited in the area around the rosettes and at all times in the laboratories.

A designated member of the scientific party will be on deck during deployment and recovery to watch wire operations until the CTD/rosette system passes 200-m on the way down and starting when it reaches 200-m on the way up to assure smooth operations. The designee will communicate immediately with chief survey technician or watch lead who has radio contact with winch operator and bridge if something is amiss. The recovery team consisting of the chief survey technician and qualified rope and hook handlers from the scientific party will be assembled on deck by the time the package is 40-m from the surface.
Discharges from holding tanks must be secured 20 minutes prior to the projected time of deployment of the CTD and again 20 minutes prior to recovery of the CTD to the surface layer. The tanks may be pumped when the cast is at depth (>200 meters) but it is preferred that discharge occurs while underway between stations. The bridge must inform the ship's engineers in advance when discharges are to be secured.

b.) **Sampling the rosette bottles** (Scientific personnel):
The usual order for drawing seawater samples on deck will be: CFCs/SF_6, helium, oxygen, pCO_2, DIC, pH, alkalinity, C14/C13, tritium, DOC, nutrients, salinity. Scientific personnel will analyze salinity samples. Two salinity samples will be drawn from the deepest (or next to deepest) bottle at each station to monitor the precision of the sampling/analysis procedures. Salinity samples will be run using *Ronald H. Brown's* Guild line 8600B Autosal instrument, complete with computer interface and laptop computer. The ship must provide a backup salinometer. The salinometers must be checked for accuracy and precision during the last US in-port before the start of the expedition. Salinity samples will be analyzed in the salinity lab off the hydrolab, and variations in laboratory temperature must not exceed 1°C during a 24-hour period. The salinity samples will also be stored in this temperature controlled area for at least 8 hours to allow them to come to ambient temperature. The Autosal will be standardized at least once each station with new vials of standard seawater. Standard seawater will be provided by the scientific personnel for use on this project. To maintain the required accuracy, it is advisable to have one person run all salinity samples. We anticipate ~100 samples/day. An accuracy of 0.003 PSS-78 or better is required, and will be monitored by scientific personnel by comparison with CTD and historical data.

Oxygen and nutrient sampling and analysis (Scientific personnel):
Samples will be collected for oxygen and nutrient analysis from each sample bottle at all stations. Nutrients will be run on board ship by members of the scientific party. Refrigerator space will be required in the main lab for nutrient sample storage prior to analysis. Nutrient measurements will be made using an AlpKem RFA system. Dissolved oxygen samples will be

"pickled" immediately after drawing using reagents in dispensing bottles located at a strategic location near the rosette. The samples will be run by members of the scientific party.

CFC/SF$_6$ ('Freon')(Scientific personnel
Water samples will be drawn for CFC and SF_6 analysis at most stations. CFC samples will be drawn first, ahead of the helium and oxygen samples. The measurements are sensitive to the high CFC levels on board ship and are therefore analyzed in a dedicated van. The chief scientists should be notified prior to any service or maintenance of the air-conditioning system and of any discharge or leakage of CFCs or solvents on the ship.

Helium/tritium samples (Scientific personnel) will be drawn at selected stations and will be extracted and stored for shoreside analysis. (Scientific Personnel) Due to the possibility of contamination, no luminous dial watches that contain tritium may be used on board the ship during this expedition. Dr. Peter Schlosser (LDEO) or his representative must be notified of any proposed use of helium gas on board ship during this expedition.

Dissolved inorganic carbon (DIC), Total Alkalinity (TALK), pH, pCO$_2$ **C14/C13,** ***Dissolved organic carbon(*****DOC)** (Scientific personnel):
DIC,TALK, pH, pCO_2, C14/C13, TALK and DOC samples will be collected from the 11-L Niskin bottles. A small quantity (~ 0.025 Ml) of a saturated solution of $HgCl_2$ will be added to the DIC, C14/C13 and DOC samples to retard bacterial oxidation of organic matter prior to analysis. DIC samples will be measured by the coulometric titration method and will be done in a temperature controlled van. Discrete pCO_2 samples will be collected from the Niskins into 500 ml volumetric flasks for analyses by IR in the ship's hydro lab. TALK samples will be measured by the potentiometric methods in the main laboratories.

Lowered ADCP (Ship and Scientific personnel):
The lowered ADCP (LADCP) will be used on all CTD/rosette casts. The instrument is a broadband, self-contained, 300 kHz ADCP, which is to be mounted to the 24-position rosette system. The instrument can be used to a depth of 6000 m. The instrument is turned on about 15 minutes prior to the launch of the CTD/rosette package using a removable cable connection to a deck box and PC computer. The deck box should be in a dry area within 10 m of the rosette. After the CTD station, about 30 minutes are required to transfer the data from the instrument and to turn it off. The LADCP may have to be removed from the rosette for repair and possible battery changes.

c.) ***Argo Float and surface drifter deployment*** (Ship and scientific personnel):
About 10 Argo floats and 10 drifters will be released during this expedition (see position table 2 below). The chief scientists will coordinate this program. These floats require about an hour of preparation prior to deployment. Preparations will be completed while the CTD is in the water. Floats will be deployed at stations immediately following recovery of the CTD and before the ship gets underway. Deployment involves lowering the ~30 kg float by hand into the water from

the stern of the ship. One or two persons from the ship and scientific party will be required for preparation and deployment.

Deployment Number	Drifter Deployments Latitude	Longitude	ARGO Deployments Latitude	Longitude
1	30S	009E	30S	6E
2	30S	006E	30S	0
3	30S	003E	30S	7W
4	30S	0	30S	10W
5	30S	003W	30S	12.5W
6	30S	015W	30S	15W
7	30S	018W	30S	17.5W
8	30S	021W	30S	25W
9	30S	024W	30S	30W
10	30S	027W	30S	40W

Table 2: Drifter and Argo deployment locations.

d.) ***Navigation*** (Ship personnel):
Navigation shall be based on the best available information including GPS, radar and visual. When GPS control is available, it is the preferred navigation method. Several GPS units must be integrated with the ship's SCS system for ADCP and LADCP measurements.

The CTD/rosette station locations listed in the table 1are nominal positions. Starting station positions along the section need only be within ~1 nautical mile of the listed position and no adjustments need to be made to the ship's position upon approach to the station to bring the starting position closer than ~ 1 nautical mile to the nominal position. Some drift during CTD/rosette casts is acceptable to maintain favorable wire angle. Exceptions will be made to these general guidelines when sampling in regions of rapidly changing bathymetry, when more precise positioning (including on site adjustments to station locations) and more precise station keeping will be required.

Navigation information will be recorded, including satellite fixes and other events as they occur. Entries should be made at least once every four hours, and at the time of each course and speed change when the ship is en route between stations (including slowdowns on arrival at the station and speedups on departure). Since copies of this information will be made and used by various project participants, it is important that the entries be checked and made clearly and dark enough for reproduction. In addition, weather observations recorded on NOAA Form 77-13d shall be made available for reproduction by the scientific party.

F. Underway Operations:

Where research clearances and conditions permit, underway measurements will be made along the entire project track, including the inland waters. The uncontaminated seawater system will

normally not be operated in harbors or other polluted areas.-Underway measurement of sea surface temperature and salinity (Ship personnel)
-Underway sea surface measurements of carbon dioxide, chlorophyll, and atmospheric measurements of carbon dioxide, CFCs, ozone and aerosols (Scientific personnel)
-ADCP (Scientific and ship personnel)
-Routine weather observations (Ship personnel).
-Center-beam Sea Beam data logging (Ship personnel).
- continuous ocean color measurements from the SAS buoy mounted on the bow tower (science personnel)Sea surface temperature and salinity will be recorded continuously with a system accurate to within 0.05°C and 0.1 PSS-78. A copy of the calibration data will be provided to the chief scientists. The Survey Department will translate the data from thermosalinograph to ASCII and plot the data on a daily basis. The thermosalinograph should be calibrated no more than six months before the start of the project.

Underway sea surface measurements and sampling (Ship and scientific personnel):
Continuous water sampling will be made from the ship's bow intake system. Ship's personnel will maintain this pump and provide adequate spare parts. This system must be capable of delivering 120 liters/minute of seawater. The system should be cleaned with bleach and flushed thoroughly at all taps prior to the project following the procedures established by the chief survey technician. Seawater will be drawn off this line to a sea/air equilibrator. Care must be taken to prevent contamination from smoke, solvent fumes, cleaning solutions, etc. Continuous underway measurements of pCO_2 will be made from one of the headspace equilibrators utilizing a LICOR NDIR Analyzer. Continuous measurements of chlorophyll will also be made using an in-line fluorometer.

Underway air measurements (Scientific personnel):
Atmospheric sampling will be conducted while underway and on station only when the wind is forward of the beam. It is desirable that the bridge notify the chief scientists if the ship's course will result in winds abaft the beam.
Air inlet cups will be mounted on the foredeck mast for collecting uncontaminated marine air. Air sampling lines will run from these inlets into the laboratory and laboratory vans.

ADCP underway operations (Ship and scientific personnel):
Data from the ADCP system will be logged continuously while underway.

Weather observations (Ship personnel):
Observations must be done at each station, and at regular intervals while underway.

Seabeam and PDR (Ship personnel):
While underway, in place of annotation of the bathymetric (PDR) chart record, Sea Beam (center beam) will be operated to obtain a continuous record of time, position and bottom depth. During CTD stations, the PDR will be required for bottom detection.

Event files

The ship shall collect 1-second heading information from the POS MV and MAHRS GPS system for comparison and testing. We request one file with
1-second data with the following:

GPS time, lat, lon, cog and sog
POS MV heading, pitch and roll
MAHRS heading (and pitch and roll if available)
Gyro heading

We request one file with
1-second data with the following:

GPS time, lat, lon, bathy depth

We also request that the chief survey technician in consultation with the chief scientist sets up special event files for the groups requesting them.

G. Small Boat Operations

Small boat operations are not anticipated for this project

H. De-staging Plan

De-staging will occur in Charleston, SC after conclusion of PNE/CLIVAR, and other projects, on a date specified by the Operations Officer. If there is insufficient space or too much weight to load any subsequent projects before returning to Charleston, Chief Scientist will arrange for unloading of necessary equipment as appropriate to accommodate.

AOML: all equipment

HUPAS: all equipment

PMEL: all equipment

RSMAS: all equipment

I. Meals and Berthing Plan

Meals are required for up to 29 scientists, 3 times daily beginning one hour before scheduled departure, extending throughout the Project, and ending two hours after the termination of the Project. All NOAA Scientists will have proper travel orders when assigned to NOAA Ship *Ronald H. Brown*. The Chief Scientist will ensure that all non-NOAA or non-Federal scientists aboard also have proper orders. It is the responsibility of the Chief Scientist to ensure that the entire scientific party has a mechanism in place to provide lodging and food and to be reimbursed for these costs in the event that the ship becomes uninhabitable and/or the galley is closed during any part of the scheduled project. Scientists may stay on the ship from the day before the Project until the day after the end of the Project.

FACILITIES

A. Equipment and Capabilities Provided by the Ship

1. Echo Sounder (Ocean Data Equipment Corporation (ODEC) Bathy 2010 or the Knudsen system) used in 12 kHz mode (to track CTD package to within 10 meters of the bottom) to be used while on CTD station.
2. Kongsberg EM122 Multibeam Mapping System (12 kHz) swath bathymetric sonar system sampling while conducting mooring operations.
3. Barometer with calibration files
4. WOCE IMET sensors with calibration files
5. Hydrographic Winch system and readouts (using 322 conducting cable for CTD operations).
5. Hull mounted acoustic Doppler current profiler (RD Instruments (RDI), 75 kHz Ocean Surveyor acoustic Doppler current profiler) with gyro input.
6. MAHRS gyro system for acquisition of heading data used by acoustic Doppler current profiler.
7. POS MV system for acquisition of heading data for testing the new MAHRS system.
8. Winch and A-frame for ATLAS deployment and recovery.
9. Two Guildline 8400B Autosals for processing salinity bottle samples. Also need a temperature controlled room stable to within one degree C.
10. A photocopier (in good working order) and paper

The above listed scientific equipment provided by the ship is all critical for meeting the objectives of this Project. However, the winch and A-frame, hull-mounted transducer, Kongsberg EM122 Multibeam Mapping System and shipboard ADCP are particularly important for satisfying the objectives of this Project

B.) Equipment, capabilities and supplies provided by scientific party:

Four 20’ container vans were loaded aboard *Ronald H. Brown* for this project. See appendix for details. Two of these containers will act as laboratory vans, and must be accessible at all times throughout the expedition. Compressed gas (non-flammable) cylinders will be used in ship's laboratories and laboratory vans.

(a) Four 24 position rosette sampling with 11 (or 12)-liter water sampling bottles and spare parts.
(b) Complete CTD recording and processing system including 3 Sea-Bird CTDs, 2 deck units, connectors, spare parts and consumables.
(c) Chemical analysis instrumentation including gas chromatographs, equilibrators, oxygen titration system, nutrient auto analyzer, coulometer, alkalinity titrator, salinity bottles.
(d) Chemical reagents, compressed gases (approximately 30 cylinders). A listing of chemicals is given in the attached spreadsheet and will be updated prior to departure from Charleston.
(e) Two Benthos pingers with spare batteries, and altimeter.
(f) Strain gage
(g) Milli-Q system, and replacement parts
(h) Two 150 kHz and three 300 KHz lowered ADCP.
(i) Surface Acquisition System (SAS)

DISPOSITION OF DATA AND REPORTS

A. Data Responsibilities

The Chief Scientists will be responsible for the disposition, feedback on data quality, and archiving of data and specimens collected on board the ship for the primary project. As representative of the program manager (Director, Climate Observation Division of the Climate Program Office), the Chief Scientist will also be responsible for the dissemination of copies of these data to participants in the project, to any other requesters, and to NESDIS in accordance with NDM 16-11 (ROSCOP within 3 months of project completion). The ship may assist in copying data and reports insofar as facilities allow.

The Chief Scientists will receive all original data gathered by the ship for the primary project, and this data transfer will be documented on NOAA Form 61-29 "Letter Transmitting Data". The Chief Scientist in turn will furnish the ship a complete inventory listing all data gathered by the scientific party detailing types and quantities of data.

Individuals in charge of piggyback projects conducted during the project have the same responsibilities for their project's data as the Chief Scientist has for primary project data. All requests for data should be made through the Chief Scientist.

The Commanding Officer is responsible for all data collected for ancillary projects until those data have been transferred to the project's principal investigators or their designees. Data transfers will be documented on NOAA Form 61-29. Copies of ancillary project data will be provided to the Chief Scientists when requested. Reporting and sending copies of ancillary project data to NESDIS (ROSCOP) is the responsibility of the program office sponsoring those projects.

The ship shall record ADCP raw data continuously during the project.

The following data products will be produced by the ship and, if requested, will be given to the Chief Scientist at the end of each leg:

a. navigational log sheets (MOAs);
b. salinity determinations;
c. calibration data for Autosals;
d. copy of SEAS data on CD or DVD;
e. CDs or DVDs of Sea Beam and navigational data, including location and depths of acoustic profile locations;
f. SCS data on CD or DVD disk;
g. ADCP raw data on CD or DVD
h. CD of two event files: summary data above, and ADCP event files

B. Pre- and Post-Project Meetings

A pre-Project meeting between the Commanding Officer and the Chief Scientist will be conducted either the day before or the day of departure, with the express purpose of identifying day-to-day project requirements, in order to best use shipboard resources and identify overtime needs. A brief post-Project meeting will be held when convenient.

C. Reporting requirements

Within seven days of the completion of the Project, a Ship Operation Evaluation form found at www.omao.noaa.gov/pdffiles/ship_eval.pdf is to be completed by the Chief Scientist. The preferred method of transmittal of this form is via email to OMAO.Customer.Satisfation@noaa.gov . If email is not an option, a hard copy may be forwarded to:

Director, NOAA Marine and Aviation Operations
NOAA Office of Marine and Aviation Operations
8403 Colesville Road, Suite 500
Silver Spring, MD 20910

If need be, upon completion of the Project, a post-Project meeting will be held and attended by the ship's officers, the Chief Scientist and members of the scientific party, the Vessel Coordinator and the Port Captain to review the Project. Concerns regarding safety, efficiency, and suggestions for improvements for future Projects should be discussed.

A Ship Operations Evaluation Report will be completed by the Chief Scientist and given to the Director, AOML, for review and then forwarded to OMAO.

ADDITIONAL PROJECTS

A. MOC Directives

Any additional work will be subordinate to the primary project and will be accomplished only with the concurrence of the Commanding Officer and the Chief Scientist.

The following projects will be conducted by ship's personnel in accordance with the general instructions contained in the MOC Directives, and conducted on a not-to-interfere basis with the primary project:

a. SEAS Data Collection and Transmission
b. Marine Mammal Reporting
c. Bathymetric Trackline
d. Weather Forecast Monitoring
e. Sea Turtle Observations
f. Automated Sounding Aerological Program

B. Underway Measurements in support of Global Carbon Cycle Research

The underway sensors on RHB will be used in support of the objectives of the Global Carbon Cycle Research (GCC) to quantify the uptake of carbon by the world's ocean and to understand the bio-geochemical mechanisms responsible for variations of partial pressure of CO2 in surface water (pCO2). This work is a collaborative effort between the CO2 groups at AOML and PMEL.

Principal investigators:
Dr Rik Wanninkhof, AOML 305-361-4379 wanninkhof@aoml.noaa.gov
Dr Richard Feely, PMEL 206-526-6214 feely@pmel.noaa.gov

The semi-automated instruments are installed on a permanent basis in the hydrolab of RHB. All work is performed on a not-to-interfere basis and does not introduce any added ship logistic requirements other than the continuous operation of the bow water pump and thermosalinograph. The chief scientist assumes responsibility of the hazardous materials aboard RHB for this project. A list of the HAZMAT associated with this project is provided in Appendix A.

HAZARDOUS MATERIALS

A. Policy and Compliance

The Chief Scientist is responsible for complying with MOCDOC 15, Fleet Environmental Compliance #07, Hazardous Material and Hazardous Waste Management Requirements for Visiting Scientists, released July 2002. Documentation regarding those requirements will be provided by the Chief of Operations, Marine Operations Center, upon request.

By Federal regulations and NOAA Marine and Aviation Operations policy, the ship may not sail without a complete inventory of all hazardous materials by name and the anticipated quantity brought aboard, MSDS and appropriate neutralizing agents, buffers, and/or absorbents in amounts adequate to address spills of a size equal to the amount of chemical brought aboard. The amount of hazardous material arriving and leaving the vessel shall be accounted for by the Chief Scientist.

B. Inventory

The Chief Scientist will provide the Commanding Officer with an inventory indicating the amount, concentrations, and intended storage area of each hazardous material brought onboard, and for which the Chief Scientist is responsible (see Appendix A). This inventory shall be updated at time of offload, accounting for the amount of material being removed, as well as the amount consumed in science operations and the amount being removed in the form of waste.

The ship's dedicated HAZMAT Locker contains two 45-gallon capacity flammable storage cabinets and one 22-gallon capacity flammable storage cabinet. Unless there are dedicated storage lockers (meeting OSHA/NFPA standards) in each van, all HAZMAT, except small amounts for ready use, must be stored in the HAZMAT Locker.

C. MSDS

All hazardous materials require a Material Safety Data Sheet (MSDS). Copies of all MSDSs shall be delivered to the ship at least two weeks prior to sailing. The Chief Scientist shall have copies of each MSDS available when the hazardous materials are loaded aboard. Hazardous material for which the MSDS is not provided will not be loaded aboard.

RADIOACTIVE ISOTOPES

Three electron capture detectors (ECDs) mounted in gas chromatographs will be stored in the CLIVAR CFC van during the project. These are low level sealed sources and ‘excepted’ materials approved for commercial transport and use. No unsealed radioactive chemicals will be used during PNE or CLIVAR.

MISCELLANEOUS

A. Meals and Berthing Plan

The Chief Scientist is responsible for assigning berthing for scientific party within the spaces designated as scientific berthing. The ship will send current stateroom diagrams to the Chief Scientist showing authorized berthing spaces. The Chief Scientist is responsible for ensuring the scientific berthing spaces are left in the condition in which they were received; for stripping bedding and linen return; and for the return of any room keys which were issued.

The Chief Scientist is also responsible for the cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the Project and its conclusion prior to departing the ship.

All persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time. All personnel must comply with OMAO's Drug and Alcohol Policy, which forbids the possession and/or use of illegal drugs and alcohol aboard NOAA Vessels

B. Medical Forms and Emergency Contacts

The NOAA Health Services Questionnaire (NHSQ, Revised: 08/08) must be completed in advance by each participating scientist. The NHSQ can be obtained from the Chief Scientist or the NOAA website at NOAA HEALTH SERVICES QUESTIONNAIRE The completed form should be sent to the Regional Director of Health Services at Marine Operations Center. The participant can mail, fax, or scan the form into an email using the contact information below. The NHSQ should reach the Health Services Office no later than 4 weeks prior to the project to allow time for the participant to obtain and submit additional information that health services might require before clearance to sail can be granted. Please contact MOC Health Services with any questions regarding eligibility or completion of the NHSQ. Be sure to include proof of tuberculosis (TB) testing, sign and date the form, and indicate the ship or ships the participant will be sailing on. The participant will receive an email notice when medically cleared to sail if a legible email address is provided on the NHSQ.

Contact information:

Regional Director of Health Services
Marine Operations Center – Atlantic
439 W. York Street
Norfolk, VA 23510
Telephone 757.441.6320
Fax 757.441.3760
E-mail: MOA.Health.Services@noaa.gov

Prior to departure, the Chief Scientist must provide a listing of emergency contacts to the Executive Officer for all members of the scientific party, with the following information: name, address, relationship to member, and telephone number.

C. Shipboard Safety

A discussion of shipboard safety policies is in the "Science User's Guide" which is available on *Ronald H. Brown* and is the responsibility of the scientific party to read. This information is also available on the ship's web page. A meeting with the Operations Officer will be held for the scientific party at the beginning of the project which will include a safety briefing. All members of the scientific party are expected to be aware of shipboard safety regulations and to comply with them.

Wearing open-toed footwear or shoes that do not completely enclose the foot (such as sandals or clogs) outside of private berthing areas is not permitted. Steel-toed shoes are required to participate in any work dealing with suspended loads, including CTD deployments and recovery. The ship does not provide steel-toed boots. Hard hats are also required when working with suspended loads. Work vests are required when working near open railings and during small boat launch and recovery operations. The ship when required will provide hard hats and work vests.

D. Communications

A progress report on operations prepared by the Chief Scientist may be relayed to the program office. Sometimes it is necessary for the Chief Scientist to communicate with another vessel, aircraft, or shore facility. Through various means of communications, the ship can usually accommodate the Chief Scientist. Special radio voice communications requirements should be listed in the project instructions. The ship's primary means of communication with the Marine Operations Center is via e-mail and the Very Small Aperture Terminal (VSAT) link. Standard VSAT bandwidth at 128kbs is shared by all vessels staff and the science team at no charge. Increased bandwidth in 30 day increments is available on the VSAT systems at increased cost to the scientific party. If increased bandwidth is being considered, program accounting is required it must be arranged at least 30 days in advance.

Contacts
Important phone numbers, fax numbers and e-mail addresses: (Up-to-date phone numbers can be found on the MOC web site at www.moc.noaa.gov/phone.htm#RB)

NOAA Ship *Ronald H. Brown* (to call from US)

- INMARSAT-B VOICE:	011-874-336-899-620	(approx $2.60/min)
- INMARSAT-B FAX:	011-874-336-899-621	
- INMARSAT "M" VOICE:	011-874-761-831-360	(approx $2.99/min)
- CELLULAR:	843-693-2082	(not while outside USA)
- OOD CELLULAR:	843-297-1835	

Note: Both the Cellular and OOD phones will work in San Juan.

- Iridium:	001-8816-7631-5690
	808-659-5690
	001-8816-7633-2352
	808-684-2352
-E-Fax:	757-299-8455

Program contacts

Molly Baringer	Molly.Baringer@noaa.gov	305-361-4345

E-mail addresses:

MOP radio room:	Radio.Room@noaa.gov
Commanding Officer, RHB	CO.Ronald.Brown@noaa.gov
Executive Officer, RHB	XO.Ronald.Brown@noaa.gov
Field Operations Officer, RHB	OPS.Ronald.Brown@noaa.gov
Medical Officer, RHB	Medical.Ronald.Brown@noaa.gov

E. IT Security

Any computer that will be hooked into the ship's network must comply with the *NMAO Fleet IT Security Policy* prior to establishing a direct connection to the NOAA WAN. Requirements include, but are not limited to:

(1) Installation of the latest virus definition (.DAT) file on all systems and performance of a virus scan on each system.
(2) Installation of the latest critical operating system security patches.
(3) No external public Internet Service Provider (ISP) connections.

Completion of these requirements prior to boarding the ship is required.

Non-NOAA personnel using the ship's computers or connecting their own computers to the ship's network must complete NOAA's IT Security Awareness Course within 3 days of embarking.

F. Foreign National Access and Deemed Export Controls

All foreign national access to the vessel shall be in accordance with NAO 207-12 and RADM De Bow's March 16, 2006 memo (http://deemedexports.noaa.gov). The foreign national's sponsor is responsible for obtaining clearances and export licenses required and for providing for required escorts by the NAO. Programs sponsoring foreign nationals should consult with their designated line office personnel to assist with the process (http://deemedexports.noaa.gov/contacts.html).

The following are basic requirements. Full compliance with NAO 207-12 is required.

Responsibilities of the Chief Scientist:

Ensure the following is provided to the Commanding Officer before any foreign national will be allowed on board for any reason:

1. Written notification identifying the NOAA Program individual who is responsible for ensuring compliance with NOAA and export regulations for the foreign national (see Foreign National Sponsor responsibilities below).
2. A copy of the DOC/OSY clearance authorization for access by the foreign national.
3. A copy of Appendix B of NAO 207-12 with NOAA Chief Administrative Officer concurrence endorsement.
4. Written notification that the foreign national has been cleared against the State, Commerce and Treasury departments' Lists to Check. http://www.bis.doc.gov/ComplianceAndEnforcement/ListsToCheck.htm
5. Provide the NOAA Foreign National List spreadsheet for each foreign national in the scientific party.

Escorts – The Chief Scientist is responsible to provide escorts to comply with NAO 207-12 Section 5.10, or as required by the vessel’s DOC/OSY Regional Security Officer.

Ensure all non-foreign national members of the scientific party receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the servicing Regional Security Officer.

Export Control - The Chief Scientist is responsible for complying with NAO 207-12 and the development of Technology Access Control Plans for items they bring aboard. The Chief Scientist must notify the Commanding Officer of any export controlled items they bring aboard and any access restrictions associated with these items.

The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.

Responsibilities of the Commanding Officer:

Ensure only those foreign nationals with DOC/OSY clearance are granted access.

Deny access to OMAO platforms and facilities by foreign nationals from countries controlled for anti-terrorism (AT) reasons and individuals from Cuba or Iran without written NMAO approval and compliance with export and sanction regulations.

Ensure foreign national access is permitted only if unlicensed deemed export is not likely to occur.

Ensure receipt from the Chief Scientist of the NOAA Foreign National List spreadsheet for each foreign national in the scientific party.

Ensure Foreign Port Officials, e.g., Pilots, immigration officials, receive escorted access in accordance with maritime custom to facilitate the vessel's visit to foreign ports.

Export Control - 8 weeks in advance of the Project, provide the Chief Scientist with a current inventory of OMAO controlled technology onboard the vessel and a copy of the vessel Technology Access Control Plan (TACP). Also notify the Chief Scientist of any OMAO-sponsored foreign nationals that will be onboard while program equipment is aboard so that the Chief Scientist can take steps to prevent unlicensed export of Program controlled technology.

The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.

Ensure all OMAO personnel onboard receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the servicing Regional Security Officer.

Responsibilities of the Foreign National Sponsor

Export Control - The foreign national's sponsor is responsible for obtaining any required export licenses and complying with any conditions of those licenses prior to the foreign national being provided access to the controlled technology onboard regardless of the technology's ownership.

The Departmental Sponsor/NOAA of the foreign national shall assign an on-board Program individual, who will be responsible for the foreign national while on board. The identified individual must be a U.S. citizen, NOAA (or DOC) employee. According to DOC/OSY, this requirement cannot be altered.

Ensure completion and submission of Appendix C (Certification of Conditions and Responsibilities for a Foreign National Guest) as required by NAO 207-12 Section 5.03.h.

G. Port Agent Services/Billing

Contractual agreements exist between the port agents and the Commanding Officer for services provided to NOAA Ship *Ronald H*. Brown. The costs for any services arranged through the ship's agents by the scientific program, in consultation with the Executive Officer , which are considered to be outside the scope of the agent/ship support agreement, will be the responsibility of that program. Where possible, it is requested that direct payment be arranged between the science party and port agent, as opposed to after-the-fact reimbursement to the ship's accounts.

H. Wage Marine Working Hours and Rest Periods

The Chief Scientist shall be cognizant of the reduced capability of *Ronald H. Brown's* operating crew to support 24-hour mission activities. Wage marine employees are subject to negotiated work rules contained in the applicable collective bargaining agreement. Dayworkers' hours of duty are a continuous eight-hour day, beginning no earlier than 0600 and ending no later than 1800. It is not permissible to separate such an employee's workday into several short work periods with interspersed non-work periods. Dayworkers called out to work between the hours of 0000 and 0600 are entitled to a rest period of one hour for each such hour worked. Such rest periods begin at 0800 and will result in such a dayworker being unavailable to support science operations until the rest period has ended. All wage marine employees are supervised and assigned work only by the Commanding Officer or his/her designee. The Chief Scientist and the Commanding Officer shall consult regularly to ensure the shipboard resources available to support the science mission are utilized safely, efficiently, and in accordance with the above policies.

APPENDICES

Appendix A. List of Hazardous Materials

Chemicals used in ATLAS buoy operations (PMEL) (PNE):

Location on ship: HAZMAT locker

Contact: David Zimmermann, NOAA/PMEL

Buoy top paint	3 gal	white, orange, black
Buoy bottom paint	2 gal	

Lithium metal batteries contained in equipment:

4 Sontek current meters 54g Li net each = 216g Li

Chemicals used in RSMAS/UM operations (PNE):
Location on Ship: HAZMAT locker
Contact: Malgorzata Szczodrak, Univ. Miami

Dilute Nitric Acid (5%)	0.5 liter	Solution
Ethanol	0.5 liter	Solution
Acetone	0.5 liter	Solution

Chemicals used in AEROSE operations (PNE):

Location on ship: AEROSE van

Contact: Nick Nalli, NOAA/NESDIS

EW-88260-96	Ethyl alcohol, denat., with up to 5% v/v ether	1 liter
EW-88189-69	Methyl alcohol p.a.	1 liter
EW-88067-49	N-Butanol (clear, colorless liquid) (25ml)	5x25 Ml

Compressed Helium	28 cylinders, each 4.5’ tall.
Compressed Air	2 cylinders, each 4.5’ tall.

Chemicals used for CFC analysis (CLIVAR)

Location on ship: CFC lab van

Contact: David Wisegarver

Chemical/compress gas	*quantity*	*unit*	*MSDS sheet*
compressed nitrogen	7	tank	CJDZH
compressed air	1	tank	BXWMN
Compressed 5% Methane in Argon	1	tank	2051
Compressed Helium	1	tank	BJZWP
Magnesium Perchlorate	2	450 gr	A6648
Ascarite	1	450 gr	A7596
Ethanol	10	pt	CKPFC

Chemicals used for nutrient analysis (CLIVAR)

Location on ship: main science laboratory

Contact: Charlie Fischer

Chemical / Compressed gas	Chemical composition	UN ID Number	Quantity	unit
NOT REGULATED				
Ammonium molybdate(VI) tetrahydrate	$(NH_4)_6Mo_7O_{24}.4H_2O$	Not Regulated	291.6	grams
Ammonium molybdate(VI) tetrahydrate	$(NH_4)_6Mo_7O_{24}.4H_2O$	Not Regulated	270	grams
Brij-35, 21% solution	$CH_3(CH_2)_{11}(CH_2CHO)_xH$	Not Regulated	60	mls
FL-70 Detergent, Biodegradable		Not Regulated	70	mls
L-(+)-Tartaric acid	$HOOC(CH_2O)_2COOH$	Not Regulated	3000	grams
N-(1-Naphthyl)ethylenediamine dihydrochloride monomethanolate	$C_{12}H_{14}N_2 \cdot 2HCl$	Not Regulated	20	grams
Potassium phosphate monobasic	KH_2PO_4	Not Regulated	3	grams
Sulfanilamide	$C_6H_8N_2O_2S$	Not Regulated	230	grams

REGULATED

Cadmium	Cd	2930	2815	grams
Copper (II) Sulfate Anhydrous	$CuSO_4$	3288	15	grams
Dodecyl Sodium Salt	$C_{12}H_{25}O_4SNa$ $CH_3(CH_2)_{10}CH_2OSO_3Na$	1325	105	mls
Hydrazine hemisulfate salt	$H_4N_2 \cdot .5H_2SO_4$	2923	96	grams
Imidazole	$C_3H_4N_2$	3263	272	grams
Potassium Nitrate	KNO_3	1486	1.2	grams
Sodium Hydroxide, 10N	NaOH	1824	4000	mls

Sodium Nitrite	$NNaO_2$	1500	1.2	grams
Sodium silicofluoride	Na_2SiF_6	2674	6.6	grams
Tin(II) chloride dihydrate	$SnCl2 \cdot 2H2O$	1759	300	grams

Chemicals used for DOC analysis (CLIVAR):

Contact: J. Blake Clark, UCSB

chemical / compressed gas	quantity unit	MSDS sheet	location of storage on ship
Paraformaldehyde, 8% solution	70 mL	CAS#50-00-0	Lab- store @room temperature in sealed container; use in fume hood
Hydrochloric Acid	2.5 L	CAS# 7647-01-0	store with corrosives/acids cabinet; use in fume hood

Chemicals used for Helium analysis (CLIVAR):

Chemical/Gas		*quanitity*	*unit*	*location on ship*	*UN ID*
Nitrogen	N2	2 Q-size	cylinder	Bio Lab	UN 1066
Oxygen	O2	2 Q-size	cylinder	Bio Lab	UN 1072
Air	Mix	2 Q-size	cylinder	Bio Lab	UN 1002
Acetone		4	liters	Hazmat Locker	UN 1090
Methanol		4	liters	Hazmat Locker	UN 1230
Isopropanol		40	liters	Hazmat Locker	UN 1219

Chemicals used for total alkalinity/pH (CLIVAR):
Location on ship: HAZMAT locker

Contact: Jason Waters

Hydrochloric acid (HCL): 2 cases

Chemical reagents used for determining dissolved oxygen in sea water (CLIVAR):

Location on ship: hydro lab

Contact: George Berberian, NOAA/AOML

Chemical	*Quanitity*	*Notes*
Alkaline Sodium Iodide	5 liters	Solution, UN 1823
Manganese Chloride	5 Liters	Solution
Dilute Sulfuric Acid (H_2SO_4)	5 Liters	Dilute Solution, UN 1830
Sodium Thiosulfate	5 vials of 30gr. Thiosulfate	Granular Salt
Potassium Iodate (KIO_3)	5 Liters	Very Dilute Solution, UN 1479

Chemicals used for DIC analysis (CLIVAR):
Location on ship: DIC van
Contact: Robert Castle, NOAA/AOML

Chemical	*Quanitity*	*UN ID*
Acetone	5 liters	UN 1090
Magnesium Perchlorate	2 0.5 g	UN 1475
Phosphoric Acid	3 0.5 liters	UN 1805
Carbon Dioxide compressed	4 1.7 CF	UN 1013
Carbon Dioxide in air, compressed	2 1.5 CF	UN 1956
Nitrogen compressed	2 1.76 CF	UN 1066
Mercuric Chloride	4 0.025 Kg	UN 1624

Appendix B. Equipment/Van List

Adequate electric power will be needed in the CFC and CO2 vans during the in port period in Cape Town for testing of the analytical instruments.

VANS/CONTAINERS:

20' Howard Univ. van (AEROSE laboratory for PNE project)
Total Weight: 15,000 lbs
Desired location: O2 deck (forward).
Loading notes: to be loaded by shore crane on 13 July. Can be loaded directly on pads (will not require a frame).

20' AOML storage van (PNE+CLIVAR equipment storage)
Total Weight: 13,600 lbs
Desired location: O1 aft
Loading notes: loaded by ship crane on July 12-13. Can be moved to O1 aft via ship's crane in Rio or Barbados to make fantail room for NTAS/MOVE.

20' AOML van (CLIVAR DIC laboratory)
Total Weight: 13,500 lbs
Desired location: fantail (O1 aft if fantail not possible; must have power)
Loading notes: loaded by ship crane on July 12-13. Can be moved to O1 aft via ship's crane in Rio or Barbados to make fantail room for NTAS/MOVE.

20' PMEL van (CLIVAR CFC laboratory)
Total Weight: 14,000 lbs
Desired location: fantail. Must have power. Air Conditioner should face forward**,** double doors facing aft. A/C won't be in place upon arrival Charleston; there will be a plate covering the hole for the A/C.

Loading notes: loaded by ship crane on July 12-13.

EQUIPMENT:

1) AOML equipment for CTD operations (PNE+CLIVAR)

Site: *loaded in oceanographic labs aboard ship except where noted otherwise*

Total weight: 1500 lbs.

1. Two altimeters, to serve as backup to the shipboard 12kHz tracking of the CTD package (PNE/CLIVAR storage van)
2. Three temperature, 3 oxygen, 3 conductivity sensors, 3 pumps, 1 CTD fish (PNE/CLIVAR storage van)

1. 4 boxes IAPSO standard seawater, 40 bottles, cardboard boxes 17"x9"x6", 35 lbs
3. sample bottles: 10 blue plastic cases, 24 x 16 x 12, 20 lb each.
4. Reagents- 2 blue plastic cases, 24 x 18 x 14, 50 lbs each
5. Two computers: 16"x16"x10", 20 lbs total
6. Two laptops, 14x2x9, 10 lbs total
7. Two LCD monitors, 16x12x2, 4 lbs total
8. Two tool boxes, 30"x16"x30", 200 lbs total
9. Two boxes misc. supplies, 16"x16"x36", 150 lbs total
10. 12 crates XBTs
11. 2 XBT computers plus hand launchers
12. oxygen titration units to measure the dissolved oxygen concentration in the water samples: aluminum boxes, 24 x 24 x 16, 70 lbs each.
13. One Laptop for Autosal room.
14. Underway CTD system (PNE/CLIVAR storage van; deployed from fantail, port side during operations): 150 lbs, plus mount.
15. Misc. supplies- 2 cardboard boxes, 16 x 15 x 14, 30 lbs each.

2) **PMEL Equipment for CTD operations (PNE+CLIVAR)**

Total weight: 2,800 lbs

1. CTD package: 1,100 lbs
   - 24-position yellow frame
   - 24 11-liter Niskin bottles
   - 400 lbs lead weights
   - Benthos 12 kHz pinger, S/N 1134
   - Metrox load cell, S/N 8755
   - 48" diameter x 78" tall blue cover

2. CTD package: 1,000 lbs
   - 24-position yellow frame
   - 24 11-liter Niskin bottles
   - 400 lbs lead weights
   - 48" diameter x 78" tall blue cover

2. CTD package: 700 lbs
   - 24-position yellow frame
   - 24 11-liter Niskin bottles
   - 48" diameter x 78" tall blue cover

3. SeaBird 24 position carousel, 60 lbs
4. SeaBird 11plus deck unit in black plastic box, 32”x21”x12”, 60 lbs
5. 2 complete .322 cable terminations, 3 turnaround kits, 3 U-shaped armor in cardboard boxes, 41”x6”x6”, 5 lbs
6. 15 boxes IAPSO standard seawater, 150 bottles, cardboard boxes 17”x9”x6”, 132 lbs
7. Dell Laptop, Panasonic Toughbook 52, Manuals, office supplies, all in white box 37”x22”x19”, 200 lbs
8. 11 grey crates containing 156x 250 ml glass sample bottles, 200 lbs
9. 1 box SeaBird spares kits and cables, 22”x22”x22”, 63 lbs
10. 1 box with 2 temperature sensors, 2 conductivity sensors, 1 reference temperature sensor, 2 oxygen sensors, 2 pumps, Benthos altimeter, 30”x19”x13”, 70 lbs
11. 1 box misc equipment (rain gear, boots, etc.), 28”x19”x17”, 30 lbs
12. 1 box SeaBird 9plus CTD, 2 temperature sensors, 2 conductivity sensors, reference temperature sensor, 1 oxygen sensor, 2 pumps, 43”x16”x18”, 70 lbs

3) **ATLAS AND T-FLEX MOORINGS (3)** (NOAA/PMEL) **(PNE)**

Total weight: 32,280 lbs

3 x buoy/tower/bridle sets – 12’ x 10’ footprint - 4,200 lbs
2 x 5980 lbs Anchors – 4 stacks, 4’ dia x 4’ high each – 11,960 lbs
5 x 4400 lbs Anchors – 4’ dia x 4’ high each – 22,000 lbs
20 reels nylon – 5’ x 10’ stacked 2 high – 4,000 lbs
6 reels Nilspin wire – 2.5’ x 7.5’ stacked 2 high – 4,200 lbs
2 reels 2x300m Nilspin wire 7.5’ stacked 2 high – 1,150lbs
Misc. mooring supplies – 4570 lbs

- 6 tube boxes with meteorological equipment – 160 lbs each
- 6 temperature module boxes – 55 lbs each
- 1 electronics boxes (laptops, telonics, etc.) – 70 lbs each
- 1 box Sontek current meters – 130 lbs
- 1 box Aquadopp current meter – 40 lbs
- 1 rolling tool box – 120 lbs
- 1 electronics tool box – 25 lbs
- 5 boxes of acoustic releases – 115 lbs each
- 2 acoustic release deck sets – 55 lbs each
- 1 hardware box – 1,150 lbs

PMEL VENTS Hydrophone moorings (5) (NOAA/PMEL) **(PNE)**

Total weight: 12,615 lbs

5 anchors, 990 lbs each, 4,950 lbs total
5 hydrophones, 176 lbs each, 880 lbs total
8pcs, 36” spools of mooring line, 125—550kg each, 4,400 lbs total
2pcs 36”x20”x16” deck boxes with shackles, chain and assorted mooring equipment, ~2000 lbs total
5 acoustic releases 30”x16”x14”, ~77 lbs each, 385 lbs total

4) 30 Satellite tracked surface drifters (NOAA/AOML) **(PNE+CLIVAR)**

Total weight: 44 lbs each= 1320 lbs total

Note: 20 to be deployed during PNE, the remaining 10 during CLIVAR.
Size: 3 pallets, 48” by 40” by 90”
SITE: Available storage space prior to deployment
Note: drifters can be removed from boxes for individual storage in forward science storage, main lab, etc. if necessary.

5) 20 Argo profiling floats (NOAA/AOML) **(PNE+CLIVAR)**

Total weight: 90 lbs each = 1800 lbs total

Note: 10 to be deployed during PNE, the remaining 10 during CLIVAR.
Size: each box (one float) 18”*18”*96”
SITE: Available storage space prior to deployment
Note: normally stored in hangar, but this should be avoided for CLIVAR (if loaded in hangar for PNE, floats would have to be moved elsewhere in Cape Town).

6) ASEXS/Helium equipment (CLIVAR)
See Appendix D for itemized list.
Total weight: 2,792 lbs
Site: biological laboratory

7) DOC/C14 equipment (CLIVAR)
Total weight: 400 lbs

8) Univ. Hawaii ADCP/LADCP (CLIVAR)
Site: AOML 20’ storage container
(Weight included in van weight)

9) Univ. Miami total alkalinity/pH equipment (CLIVAR)
Site: AOML 20’ storage container
(Weight included in van weight)

10) Univ. California Santa Barbara equipment (CLIVAR)
Total weight: 250 lbs
Site: forward science stores
1. Box with sampling equipment, 41.75”x18.25”x22.75”, 76 lbs
2. Box with sampling equipment, 41.75”x18.25”x22.75”, 76 lbs
3. Box with sampling equipment, 28”x16”x16”, 35 lbs
4. Box with sampling and misc. equipment, 34”x17”x17”, 57 lbs

11) HUPAS/NESDIS/PSD equipment (PNE)
Site: radiometers, counters and samplers mounted on railing O1 deck.
Helium cylinders: O1 deck aft near aft starboard railing (behind stairs).

1. Helium cylinders: 30, with racks, 4.5' tall
   Weight: 143 lbs each = 4,290 lbs total
2. Microtops sun photometers
3. Vaisala ozonesondes
4. Cascade impactors
5. RAAS high volume sampler
6. Laser particle counter
7. MFRSR
8. Microwave radiometer
9. Broadband pyranometer and pyrgeometer
10. Trace gas instruments O_3, CO, SO_2
11. CCN counter

NOAA/NESDIS equipment:

1. Vaisala RS92 rawinsondes

NOAA/PSD equipment:

1. Vaisala GPS-based sounding system
2. Ceilometer
3. Broadband flux radiometer

12) UM/RSMAS equipment (PNE)

The RSMAS equipment is described in more detail in Appendix C

Instrument	*Preferred Location*	*Power*
Marine-Atmospheric Emitted Radiance Interferometer	O2 deck to view sea surface ahead of the bow wave.	120 V A/C, 2 kW maximum, 800W normal.
Weather station	Forward railing O2, O3 deck or above bridge	120 V A/C, 1 W
Surface temperature float	Deployed by hand from the foredeck, computer in the hangar	120 V A/C, 20 W
All-sky camera	O2, O3 deck or above bridge	120 V A/C, 15 W
Microwave radiometer	O2, O3 deck or above bridge	120 V A/C, 1 kW max
Optical Rain Gauge	O2, O3 deck or above bridge	120 V A/C, 25 W

Site: Main laboratory; 6-foot contiguous bench space, storage space, 1 seat

Appendix C: UM/RSMAS Sea-going Equipment (PNE)

Point of Contact:

Peter J. Minnett

Meteorology and Physical Oceanography
Rosenstiel School of Marine and Atmospheric Science
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Table C1 Measured and derived variables and sensors.

Variable	Ship-based Sensor
Skin sea-surface temperature	M-AERI, ISAR
Bulk sea-surface temperature	Surface-following float
Infrared spectra of surface emitted radiation	M-AERI
Infrared spectra of atmosphere emitted radiation	M-AERI
Direct/diffuse SW↓; aerosol optical thickness	PRP (MFRSR)[#]
Cloud type and cover	All-sky camera
Insolation (SW↓)	Gimbaled Eppley pyrometer
Incident thermal radiation (LW↓)	Gimbaled Eppley pyrgeometer
Columnar water vapor	Microwave radiometer
Rainfall	Optical rain gauge
Air Temperature	Thermistor*
Relative humidity*	Vaisala "Humicap" *
Wind speed*	R. M. Young anemometer*
Wind direction*	R. M. Young anemometer*
Barometric pressure*	Digital barometer*
**Part of Coastal Environmental System's "Weatherpak"* [#] *To be confirmed*	

Table C2: Summary of instruments, preferred location and power requirements.

Instrument	*Preferred Location*	*Power*
Marine-Atmospheric Emitted Radiance Interferometer	Starboard side railing. Deck O2 ahead of the Bridge	120 V A/C, 2 kW maximum, 800W normal.
Weather station	Forward railing above Deck O2 or O3	120 V A/C, 1 W
Surface temperature float	Deployed by hand from the foredeck, computer in Main Lab	120 V A/C, 20 W
All-sky camera	Starboard side railing. Deck O3 ahead of the Bridge	120 V A/C, 15 W
Microwave radiometer	Starboard side railing. Deck O3 ahead of the Bridge	120 V A/C, 1 kW max
PRP	Forward railing above Deck O2 or O3	120 V A/C, 10 W
Optical Rain Gauge	Starboard side railing. Deck O3 ahead of the Bridge	120 V A/C, 25 W

Notes:
a) Equipment on O2 deck on starboard railing
b) Weather station on centerline of ship
c) Other than MAERI and hard hat, equipment can be on O3 or O2 deck
d) Hard hat is deployed by hand on station
e) MAERI cable to Main Lab

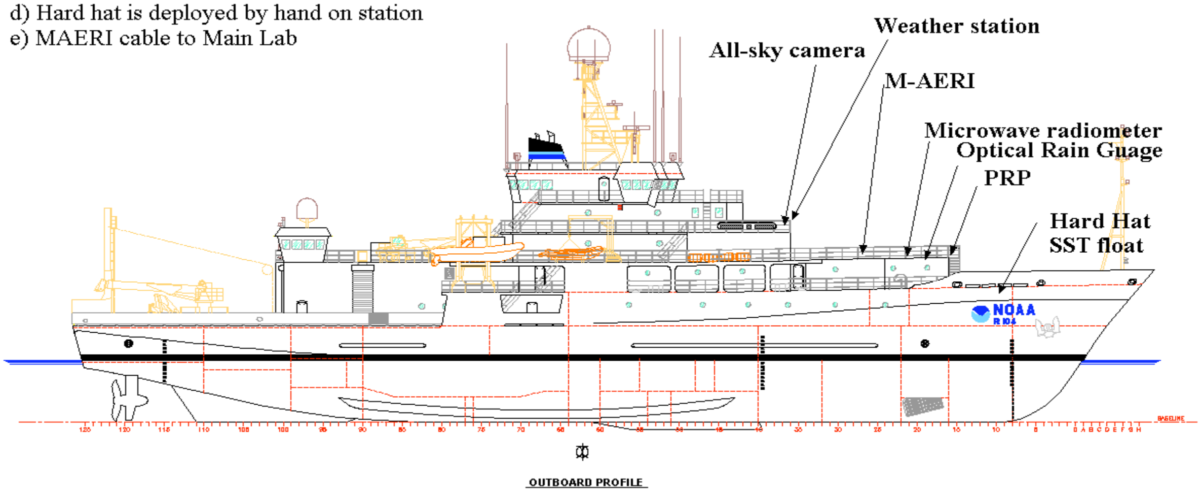


Figure C1. Suggested layout of Minnett equipment for PNE

The layout suggested in Figure C1 is a compromise between the measurements being made with a minimum of influence from the ship, cable lengths, and access for maintenance. The M-AERI cable length is such that the external unit can be mounted to give a clear view of the sea ahead of the bow-wave, and have the electronic rack in the Main Lab. The rack has to be close (within

10ft) of the main aft doors of the Lab. Other computers, electronics components and printer require about 12 linear feet of bench space and it would be more convenient for this bench space to be allocated close to the M-AERI electronics rack. Other than the M-AERI and hard hat float, the instruments can be mounted on railings on the O2 or O3 deck, a choice that will be made dependent on the layout of other senor sans vans, with the objective of obtaining as clear a view of the sky as possible while still permitting access during the Project.

Access to the instruments is required for:

a) M-AERI: covering the instrument for heavy rain of sea-spray
b) PRP: cleaning the radiometer domes
c) All-sky camera: cleaning the mirror and lens
d) Weather station: cleaning the mirror and lens
e) Hard-hat float: deployment and recovery

Figure C2a. M-AERI mounted on starboard side railing on the O2 deck of the *Ronald H Brown*. The instrument is covered by a tarpaulin, which is the case when there is heavy rain or sea-spray. Measurements are not taken while covered.

Figure C2b shows the interior equipment in the Met Lab on the USCGC *Polar Star* (keyboard, flat-panel display, laptop computers and video monitors) on the far bench in the lab. (A printer was mounted on another shelf off the photograph.)

A description of the individual sensors follows.

A – The M-AERI

Our main piece of equipment is the M-AERI (Marine-Atmosphere Emitted Radiance Interferometer – see Minnett, P. J., R. O. Knuteson, F. A. Best, B. J. Osborne, J. A. Hanafin, and O. B. Brown (2001), The Marine-Atmospheric Emitted Radiance Interferometer (M-AERI), a high-accuracy, sea-going infrared spectroradiometer, Journal of Atmospheric and Oceanic Technology, 18, 994-1013). It is a bulky piece of equipment which sits on a table that mounts on the railing where it can view the surface of the sea ahead of the bow wave, at an angle of about 55^o to the vertical. On the Ronald H Brown, this is on the O2 deck (Figure C2a). The M-AERI electronics rack is usually installed in the Main Lab. The cable connecting the M-AERI to the electronics rack is a thick 'umbilical' bundle (about 5 cm diameter). We provide all of the mounting structure for the MAERI, so there are no special requirements from the ship for this, only that the area where we install it be available. In order to get the MAERI components to the appropriate deck we require a crane – the weight is 280kg.
Power for the M-AERI is provided via cables to the interior lab. We provide an isolation transformer as well as a UPS unit. Power requirements are maximum ~2 KW.

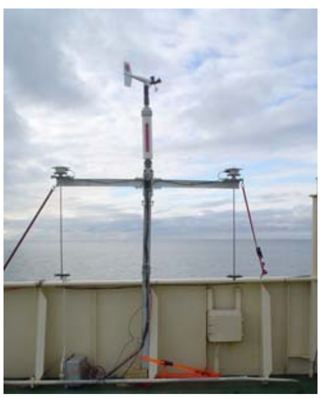


Figure C3. Weather station mounted

B- Meteorology and incident radiation

We set up a Met package on the forward railing of the O2 deck or above the bridge. Parameters measured are wind speed and direction, air temperature and humidity, surface air pressure and incident long and short wave radiation (Eppley radiometers mounted on gimbals with pendulums (Figure C3). Power is provided via cables to the Lab. Power requirements are 120 V A/C, 0.2 amps.
We also set up a set of instruments called a PRP (Portable Radiation Package) which measures spectrally resolved incident

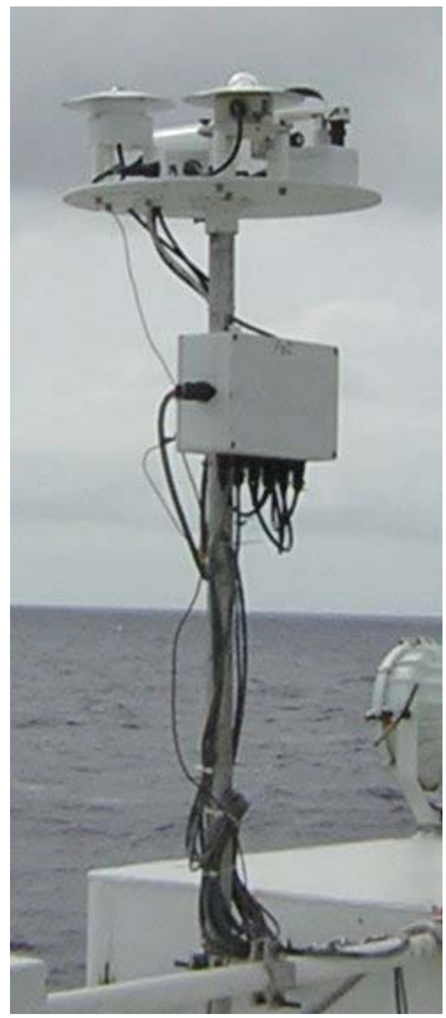


Figure C4. Portable Radiation Package on RHB during the AMMA 2006 project.

solar radiation, for the determination of aerosol parameters. This usually is mounted on the flying bridge (Figure C4). Power is supplied via cables to the Lab. We provide a D/C power supply.

Figure C5. Sky camera setup on the bridge top of the RHB during the AMMA 2006 project.

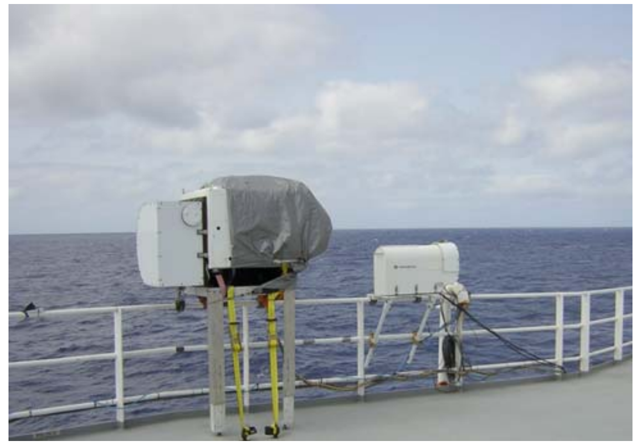


Figure C6. Microwave radiometer next to the M-AERI on the RMB during the AMMA 2006 project

C - All-sky camera

We mount a sky camera system where as unobstructed as possible view of the dome of the sky is available such as on the bridge top (Figure C5) All of the mounting structure is provided by us, there are no additional requirements from the ship. Power is supplied from to the Lab where the images are acquired by a laptop computer 120 V AC, 50 watts.

D - Microwave radiometer

We set up a Microwave Radiometer where ir has a clear view from zenith to the horizon. It measures atmospheric precipitable water, and cloud liquid water content, (Figure C6). The instrument mounts conveniently on the stand shown in the photo, but can be adapted to mount without the stand if there is a more suitable location. Power for this instrument is provided via cables into the Lab. Power requirements for the radiometer are 120 V AC, 1 amp. The instrument also has an air-blower fan which requires 120 VAC; 1 kW.

E – Near surface bulk temperature.
The near surface bulk sea temperature is measured by a

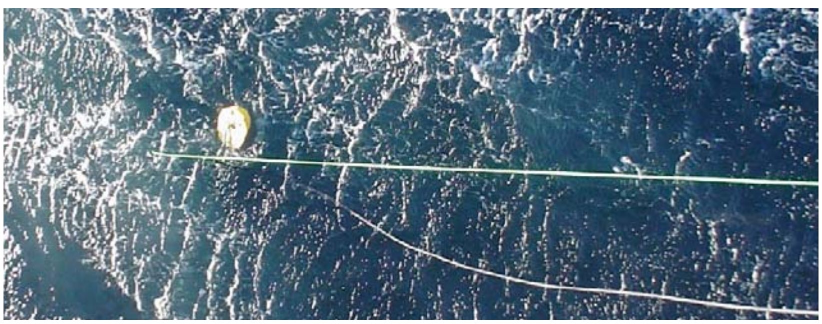
precision thermistor mounted in a small surface-following float constructed from a “hard hat” (Figure C7). This is deployed by hand when the ship is on station, drifting or making way at less than a few knots (dependent on sea state). The thermometer is at a nominal depth of 5cm and is sampled every second, and 20-s averages are logged by a laptop computer.

FigureC7. The Hard–Hat float of the port bow of the R/V Tangaroa, when seen from above.

Figure C8. Optical RainGuage

F - Optical rain gauge

The optical rain gauge measures liquid precipitation (Figure C8). The data are logged by a laptop computer in the lab.



Appendix D: ASEXS equipment (CLIVAR)

Total weight: 2,792 lbs
Site: biological laboratory

Point of Contact:

Bob Castle, NOAA/AOML
Robert.Castle@noaa.gov

BOX #	SIZE	WT (LBS)	MODEL	Description	SN	Country of Manufacture	Value (USD)
				ASEXS EQUIPMENT LIST			
1	51x23x23	220	Custom	2 Electronics control units (SB-4, SB-2)	NA	USA	6000
			330	Granville Phillps ion Gauge contoller	4366	USA	2400
			330	Granville Phillps ion Gauge contoller	4364	USA	2400
			316	Granville Phillps Convectron contoller	2583	USA	2300
			316	Granville Phillps Convectron contoller	1849	USA	2300
			NA	Electronic Supplies	NA	USA	1000
			LATITUDE	DELL Portable PC	D600	USA	2500
			LATITUDE	DELL Portable PC	E6500	USA	2500
2	25x22x51	266	P-75	Polycold Cold Trap	41490	USA	14200
3	17x26x27	173	M33	ThermoNeslab Water Chiller	106307013	USA	2500
4	26x26x44	214	Custom	Extraction System Pumping Station (ASEX 2)	NA	USA	5000
5	25x22x51	266	P-100-ST	Polycold Cold Trap	K0938207	USA	15000
6	46x17x38	142	Custom	Helium 8 section extraction system (ASEX 2)	NA	USA	6200
7	17x26x27	164	M25	ThermoNeslab Water Chiller	103002085	USA	2500
8	14x28x18	84	NA	Extraction line spare parts and tools	NA	USA	5000
9	15x28x21	78	NA	Extraction line spare parts and fittings	NA	USA	3000
10	14x28x25	74	NA	Laboratory Supplies and Hardware	NA	USA	2000
11	16x28x21	75	NA	Laboratory Supples & Electronics Supplies	NA	USA	1900
12	14x28x18	53	NA	Laboratory Supples/Sampling Hardware	NA	USA	4000
13	48x12x12	27	NA	Hardware	NA	USA	80
14	48x12x12	10	Custom	Extraction Manifold	NA	USA	1200
15	13x30x12	72	SD-200	Varian Mechanical Pump	210050	USA	2400
16	15x25x12	74	SD-200	Varian Mechanical Pump	119201	USA	2400
17	15x25x12	79	SD 200	Varian Mechanical Pump	269307	USA	2400
18	16x15x23	70	NA	Sample cylinders and extraction sections	NA	USA	23000
19	11x11x43	85	NA	Gas cylinder	NA	USA	250
20	11x11x43	87	NA	Gas cylinder	NA	USA	250
21	11x11x43	97	NA	Gas cylinder	NA	USA	250
22	9x10x43	96	NA	Gas cylinder	NA	USA	250
23	9x10x43	97	NA	Gas cylinder	NA	USA	250
24	9x10x43	93	NA	Gas cylinder	NA	USA	250
25	18x9x9	9	NA	Acetone, 4 liters	NA	USA	100
26	18x9x9	9	NA	Methanol, 4 liters	NA	USA	120
27	15x12x12	39	NA	Isopropanol, 20 liters	NA	USA	250
28	15x12x12	39	NA	Isopropanol, 20 liters	NA	USA	250

Appendix E: SAS equipment (CLIVAR)

BioOptical and Phytoplankton Studies in the South Atlantic

Contact: Carlos A. E Garcia[1] and Aurea M. Ciotti[2]
[1]Institute of Oceanography, University of Rio Grande, Rio Grande, Brazil
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The understanding and quantification of the CO_2 fluxes between ocean and atmosphere are closely associated with knowledge of the hydrographic structure, and how it facilitates nutrient intakes and the accumulation or dispersion of the organic material produced by the primary producers (Cullen et al. 2002). However, the use of CO_2 at the sea surface by phytoplankton and microbial community depends on their specific composition and dominant cell size, and its length of stay in a given place, mediated by physical processes, grazing, and subsequent regeneration of nutrients by zooplankton (Ilsa et al. 2004) and sedimentation (Ducklow et al. 2001). Thus, understanding carbon fluxes in the ocean depends on multidisciplinary studies, and engaged in order to quantify the relationships between hydrodynamics, the supply of nutrients in the upper layers, and the dynamics of microorganisms.

We have been conducting bio-optical measurements (in the last 15 years) and CO_2 fluxes (in the last 4 years) in the in the South Atlantic and Southern Ocean aiming to (a) to improve the quality of existing optical remote sensing products derived by satellites (ex. SeaWiFS, MODIS, MERIS); and (b) to develop new products (including primary production and partial pressure of CO_2) based on *in situ* and remotely sensed data. In the past four years, we have also incorporate phytoplankton taxonomical composition. In the upcoming NOAA's project, we would like to expand this long-term objective over the subtropical South Atlantic gyre, and thus increase our understanding on the relationship between air-sea CO_2 fluxes, environmental conditions, phytoplankton community, and optical properties in the oceanic upper layer.

We also have the following specific objectives: (a) To quantify and determine the spatial and temporal variability of apparent and inherent optical properties of seawater; (b) To quantify the phytoplankton biomass (chlorophylla) and composition of functional groups through accessory pigments; (c) To discriminate phytoplankton communities based on thermohaline structure, levels of macronutrients, their size classes, major taxonomic groups, and optical properties; (d) To validate ocean color products (chla, absorption, CDOM, etc) by comparing in-situ measurements with those estimated by satellite images.

Requirements and optical systems

We believe we can collaborate with NOAA's objective and add new measurements in the South Atlantic by performing casts of optical instruments and also filtering samples for HPLC determination of pigments. In addition, using the filtrate of the HPLC we should be able to run CDOM samples on board. For the HPLC samples, we need a small bench space to set up a filtration apparatus and a vacuum pump, and we need to have a liquid nitrogen dewar to store filters during the project.

For CDOM samples, we need also some small bench space to set up our radiometer and several liters of milli-Q water. We will follow NASA's protocols and have the samples processed immediately after the collection, but we will bring a number of glass bottles to store samples, that need to be kept in about 4 degrees C, just in case.

Optical Systems

Regarding optical measurements, the following independent optical systems will be used during the project: (a) *Surface Acquisition System (SAS)* (Satlantic) (b) Optical Cage, and (c) free-fall optical profiler. The SAS operates continuously along the ship's track and during stations, while both the optical cage and the profiler are deployed only during CTD stations. The Surface Acquisition System (SAS) is mounted on vessels to provide continuous monitoring of ocean color along the ship's track. Usually, SAS is mounted on ship's bow to avoid the foam' effects on ocean color. The main advantage of the system is it's small size and extremely fast sampling rate. We have a special tower to install SAS, as close as possible to the ship's bow, to avoid the ship's wake. SAS also needs NMEA data, so ship's position is automatically added to the radiometric data along the ship's track.


SAS: Surface Acquisition System

The free fall system has a 200 m cable, and is deployed to about 30-45 meters maximum. The profiler is easily deployed at stern of the vessel by hand. The free-fall profiler needs 2 (two) people to operate it (one at deck and other controlling the profiler using a laptop on ship's deck). Usually we deploy it at beginning of each CTD station when the ship is parking for a CTD station. As this instrument uses natural light, the deployments can be performed from around 9AM to about 5PM local time. No extra time is needed during a CTD station.


Optical Free fall system